

Study of Solvent and Catalyst Interactions in Direct Coal Liquefaction

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ABSTRACT

In our previous direct coal liquefaction work using the Short Contact Time Batch Reactor (SCTBR) we have had recovery of product of approximately 75 to 85%, due to hold up of the reaction mixture in the preheater, precooler and also in the blow case. This has forced us to determine conversion by use of aliquots and using an ash balance. This has worked out quite well when we were running coal liquefaction reactions without catalyst or were using small amounts of soluble catalyst which did not leave significant amounts of mineral matter in the product. Now however, we are interested in running catalyzed liquefactions with solid and often supported catalysts which contribute significant amounts of mineral matter to the reaction system, thereby reducing the precision of the conversion determination. It therefore has been important to develop a method of determining conversion by other means. To do this, we have redesigned the reactor system to increase the recovery by reducing the holdup of material in the system. This was done by redesigning the blow case so there is little or no bypassing of the compressed gas used to drive the reaction mixture into the reactor, by changing the condenser system so that there is less hold up there and to reduce the length of the tubing in the preheater and precooler.

With these changes, we have been able to increase our recovery to the range of 90 to 95%. This should permit a more accurate determination of conversion by product material balance provided one determines the amount of tetralin solvent in the recovered liquid product and the solids content in that product. The solids content is determined by filtration and weighing of the insoluble material. For the tetralin content, a gas chromatographic method on the liquid portion of the reaction mixture has been developed, using methyl naphthalene as the reference standard.

A basket is being fabricated to hold catalyst in the SCTBR reactor during liquefaction. This is designed to hold the solid catalyst in the reaction mixture during the reaction, but be able to be recovered after rinsing with the solvent for studies of catalyst activity and changes that may have taken place.

This should allow the testing of various solid catalysts for activity and to separate them from the reaction mixture after the reaction is finished so that the high mineral catalyst will not interfere with the conversion determination. Various catalyst compositions both coated and uncoated will be tested. The first basket that was fabricated needed to be modified to allow better penetration of the liquid mixture to the catalyst. That modification is in progress.